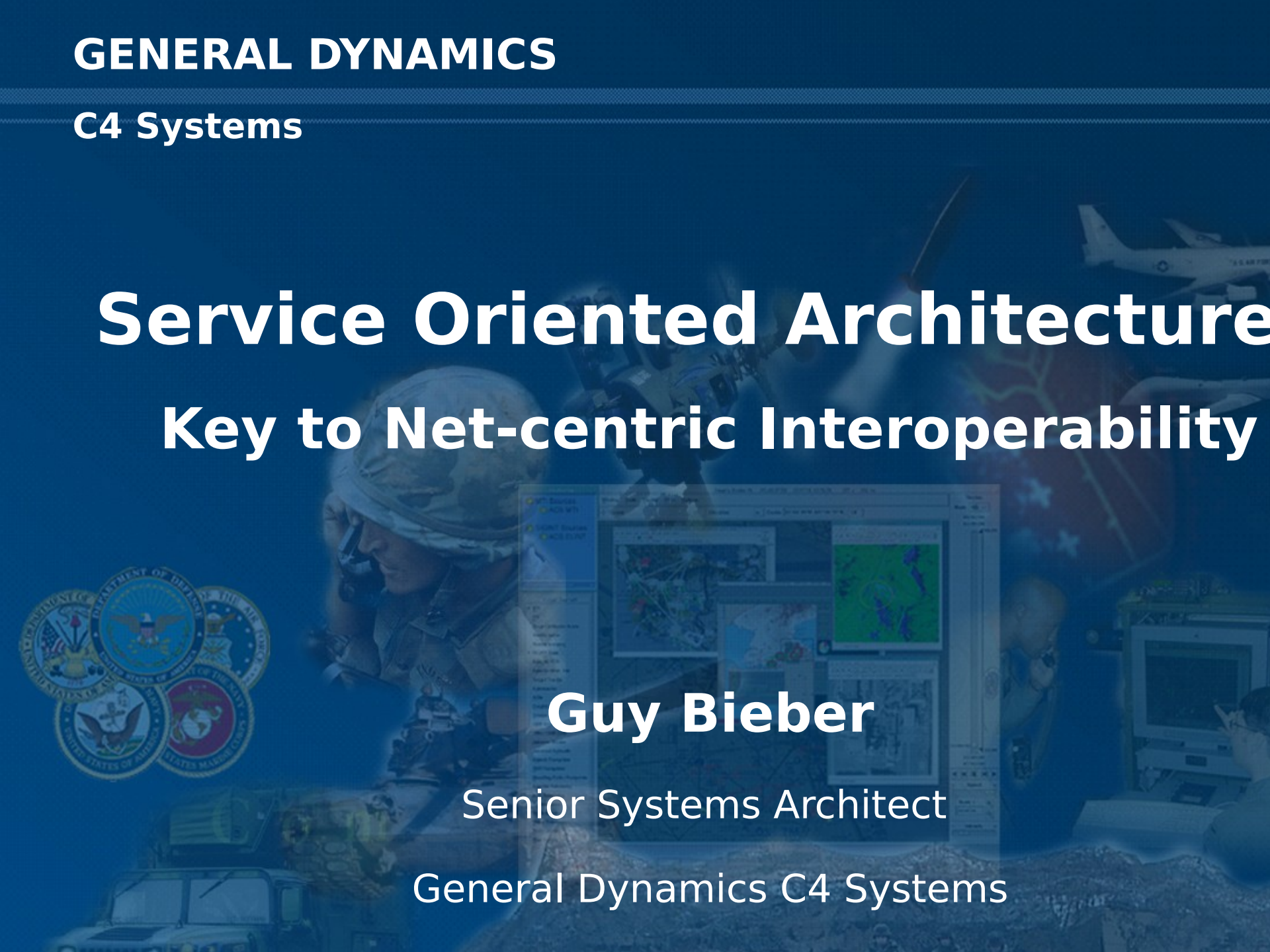
GENERAL DYNAMICS

C4 Systems

Service Oriented Architecture

Key to Net-centric Interoperability



Guy Bieber

Senior Systems Architect

General Dynamics C4 Systems

Transformation

- **System-Centric -> Net-Centric**
  - ➤ Remove barriers for Warfighters
  - Power shift from producers to consumers
- **Point Integration -> Horizontal Fusion**
  - Stovepipes -> Network Services
  - Open ended integration to combine capabilities in new ways.
- **Data Centric -> Process Centric / Knowledge Centric**
  - Not just about moving the data.
  - What does it mean? What should you do?
  - Software is helping to draw conclusions from the data and participating with users in decision workflows.

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Interoperability: How are we doing?

- **Many improvements, but not yet enough**
  - IP networking enables process communication
  - Wire/fiber communications are a “done deal”
  - RF systems becoming software-configurable
  - The “Application Layer” is the real challenge

Tomorrow’s military must rely even <u>more</u> on information sharing and collaboration in near-real time

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What Do Our WarFighters Need?

- **Ease of use**
  - Reduced training load
  - Ability to focus on fighting, not IT
- **Rapid access to current/useful *interpretation* of information**
- **Flexibility**
  - Adapt to changing conditions and partnerships
  - Collaborate with US/Allies/Coalition & even Non-Governmental Organizations
- **Survivability**
- **Reliability/Availability**

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Problems and Constraints

- **Software stovepipes exist, resist and persist**
  - Absent architectural change, they'll outlive us
  - What's the right change?
  - Can we effectively achieve one?
- **Industry and Services require encouragement**
- **"Programs of Record"**
  - Today's primary method for allocating funding
  - PORs are inclined to fight off non-POR "invaders"

Must "Do No Harm" while enabling radical change

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Barriers to Interoperable Net-Centricity

- **We haven't agreed on how to connect components**
  - There are hundreds of middleware products/standards
- **Widely-used client-server model is static and brittle**
  - Interfaces are private, leading to stovepiped systems
- **Present systems assume static, reliable networks**
  - Tactical networks are not highly available or reliable
  - Future networks will still be highly dynamic
- **Much existing application software is "hard-wired"**
  - Far too much embedded context dependent information

Proper adoption of SOAs <u>can</u> remove these barriers

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Evolving to Revolutionary Capability

- **Numerous challenges exist**
  - Procedural (e.g. CONOPs and TTPs)
  - Bureaucratic (Industry/Service stakeholders)
  - Financial (who pays and who loses?)
  - Technical – perhaps the easiest
- **Start the journey with a first step**
  - Commit to embracing interoperable architectures
  - Adopt Service-Oriented Architecture principles

SOA's designed to accommodate change - allows DoD to leverage <u>business</u> innovation

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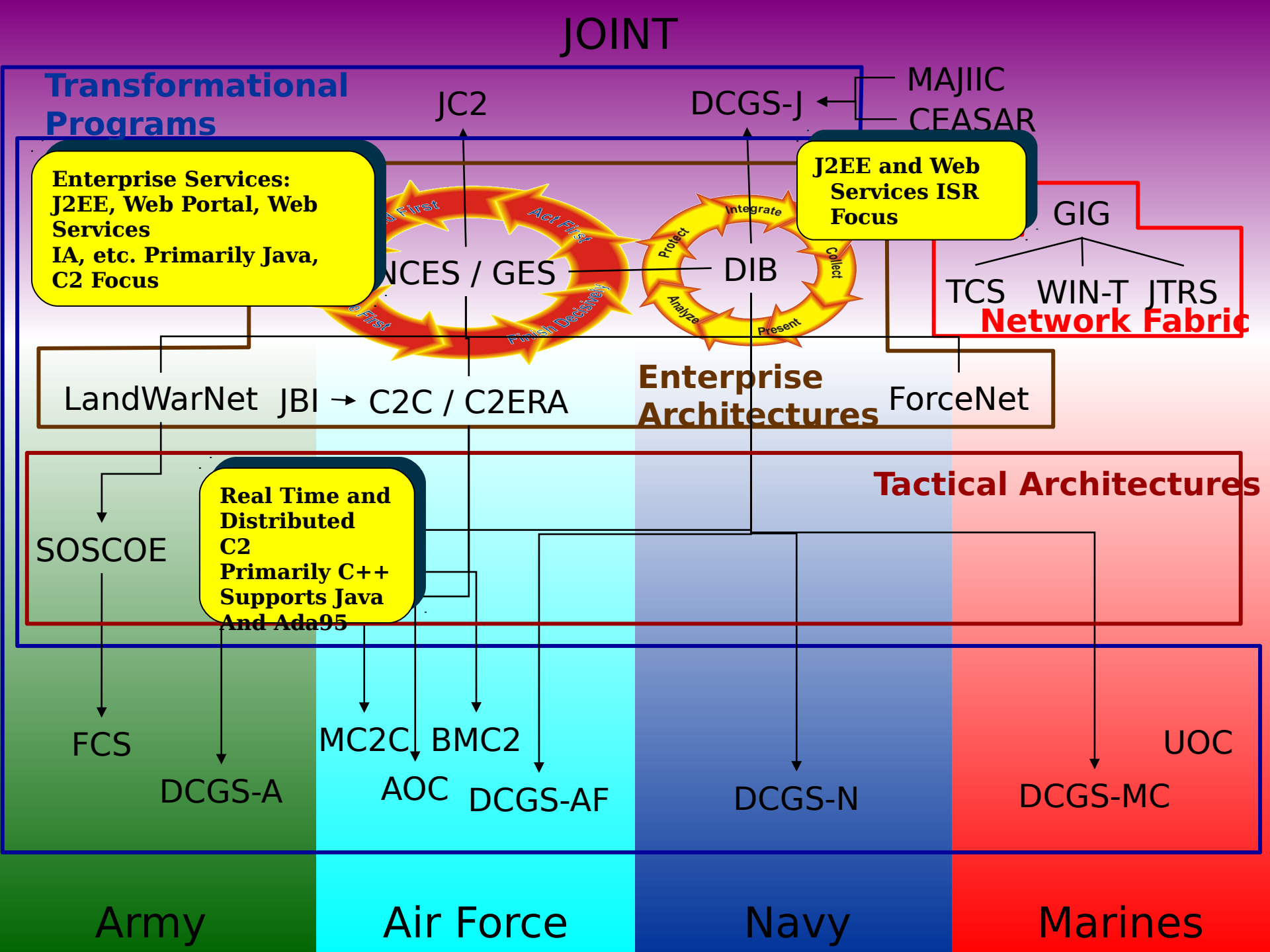
JOINT
Transformational Programs
JC2
DCGS-J
MAJIIC
CEASAR
Enterprise Services: J2EE, Web Portal, Web Services IA, etc. Primarily Java, C2 Focus
J2EE and Web Services ISR Focus
NCES / GES
DIB
GIG
TCS
WIN-T
JTRS
Network Fabric
LandWarNet
JBI → C2C / C2ERA
Enterprise Architectures
ForceNet
Tactical Architectures
SOSCOE
Real Time and Distributed C2 Primarily C++ Supports Java And Ada95
FCS
DCGS-A
MC2C
BMC2
AOC
DCGS-AF
DCGS-N
UOC
DCGS-MC
Army
Air Force
Navy
Marines

The Net-Centric Landscape

- **Enterprise and Architectures are still evolving**
  - Existing complex and competing architectures
  - Emergent and evolving architectures
    - For instance: LandWarNet and C2 Constellation
- **Warfighter applications will need isolation from changing operational environments**
  - Change will continue
  - We will need to provide means for interoperability across enterprise networks for a

SOAs enable interoperability across different enterprise and tactical network architectures

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Why Service Oriented/Based Architectures?

The problems we need to solve today are not necessarily yesterday's problems

- Therefore systems to solve today's problems may not be the system we had yesterday

A military example:

- If we do not know who our enemy is tomorrow or what his approach will be, we cannot predict with precision what capabilites (read "services") our military systems will need or how our capabilities may need to be combined in

Dynamic environments require dynamic systems
SOA/SBA focus on dynamic distribution of services reduces system formation cost

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Potential Pitfalls to Implementation

- **Leadership**
  - Someone (Joint) needs to “be in charge”
  - Achieving “buy in” across the Community
- **Rice Bowls**
  - Numerous redundancies exist in legacy PORs
  - Will cooperation protect programs? Obstruction?
- **Application vs. infrastructure services**
  - Can net proliferations be contained and concentrate on applications?
- **Security concerns across the enterprise**

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What's a Service Oriented Architecture?

- **Built around a collection of reusable software components with well-defined interfaces**
- **Components may perform work ("service") for others on a network, and inherently provide:**
  - Ability to "discover" the existence of services
  - Ability to convey information necessary for usage
    - Descriptions, including formats & protocols

SOAs enable dynamic formation of systems and net –
critical for effective net-centric operations

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Some Potential SOA Benefits

- **Ease integration across heterogeneous environments and applications**
- **Facilitate reuse of existing applications**
  - Facilitate efficient integration of existing systems
  - Reduce retraining impact of new major systems
  - Allow evolution by facilitating deployment of "best of breed" capabilities
  - Accelerate transition to integrated functionality

Business (warfighting) processes should drive decisions on technical specifics – not the converse!

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A Few Key SOA Principles

- **Identify & expose specific sub-functions that existing applications can execute for others**
- **Agree to common interface standards**
- **Leverage existing tools in business world**
  - Inter-process messaging
  - Publish and subscribe
  - Web Services
  - Deployable network services

Objective is "loosely coupled" aggregation of services

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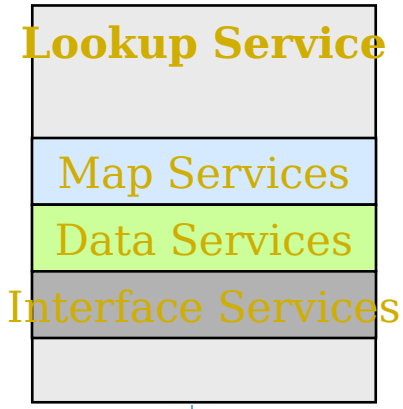
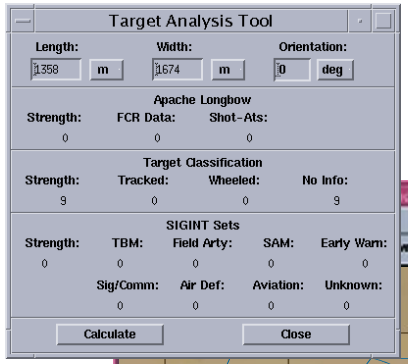
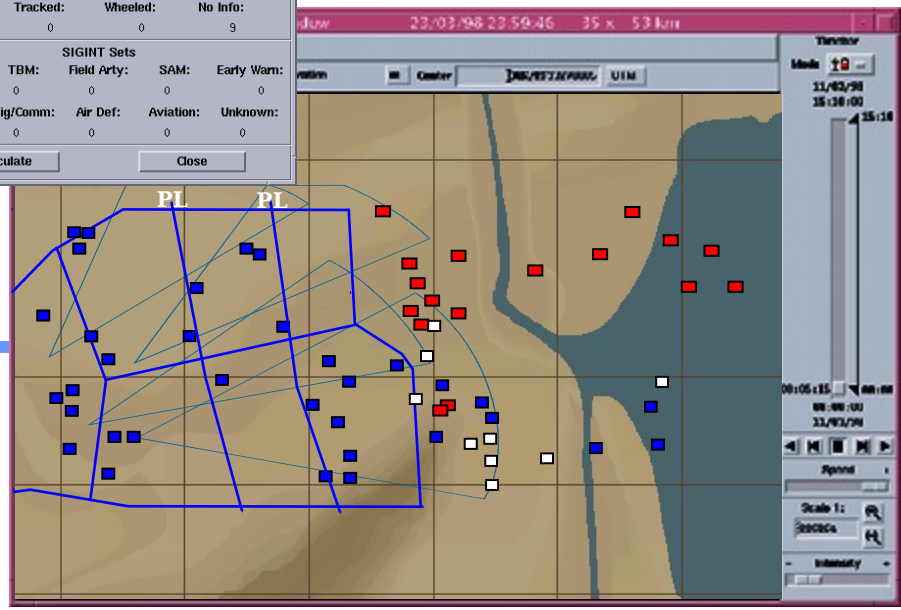
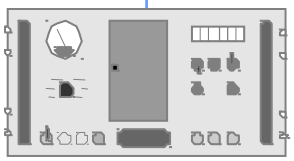
Ad-hoc Component Integration







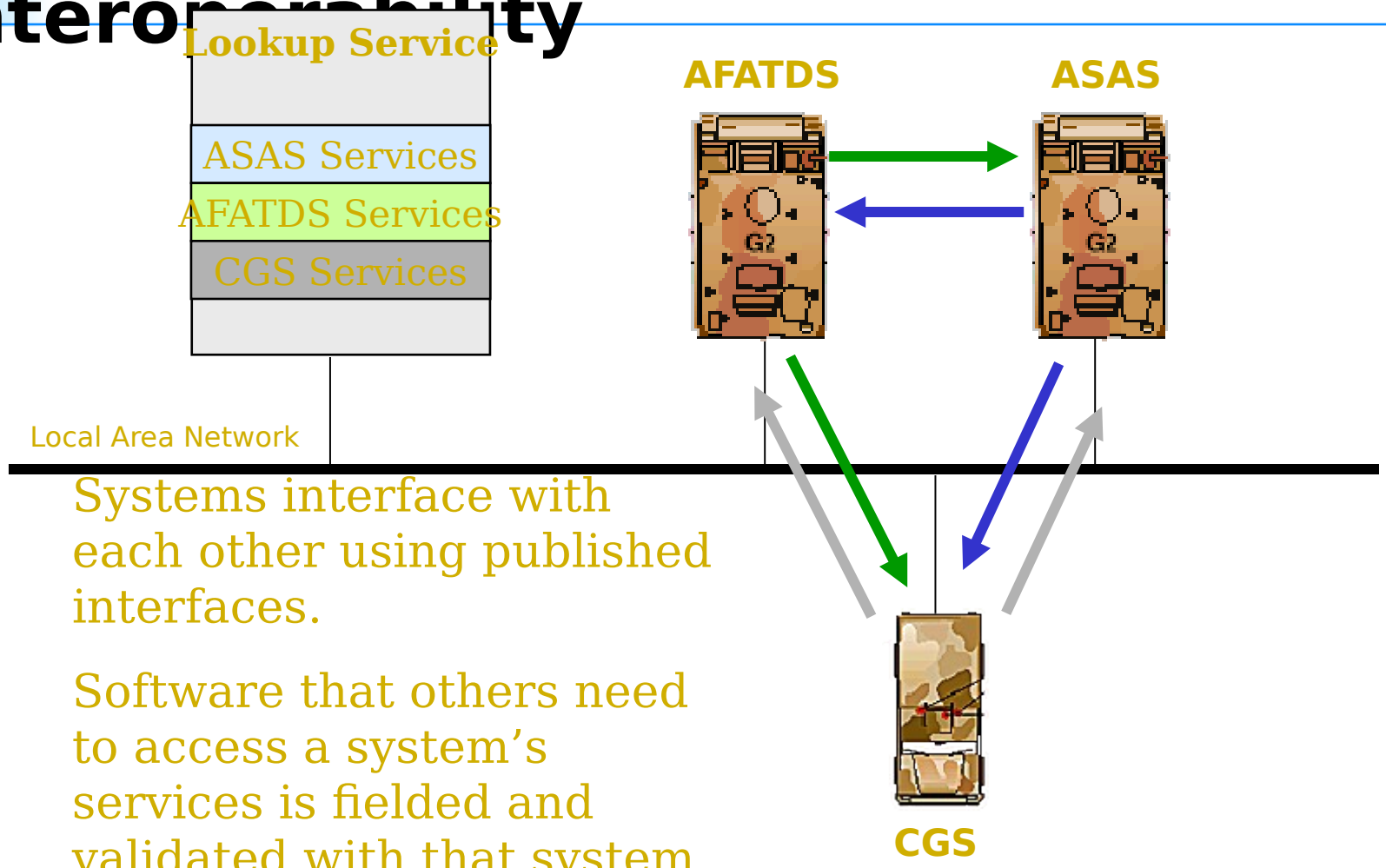


Database

Map Server

Normalized Data

System of Systems Interoperability



Systems interface with each other using published interfaces.

Software that others need to access a system's services is fielded and validated with that system.

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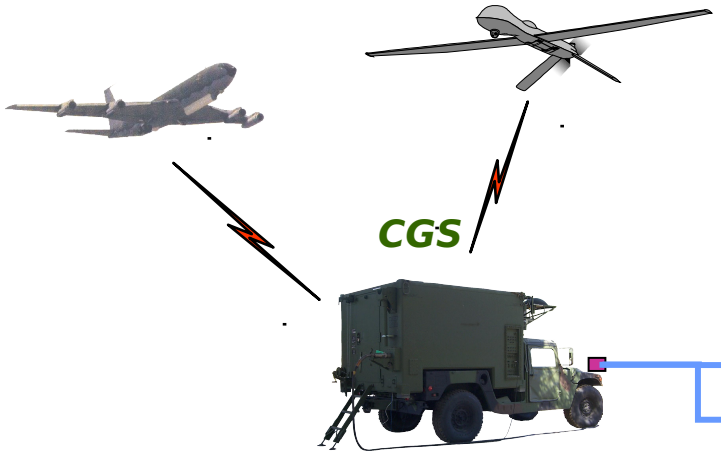
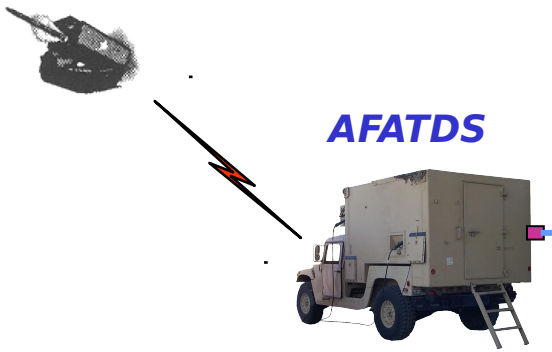
Distributed Services





Visualization Service Framework

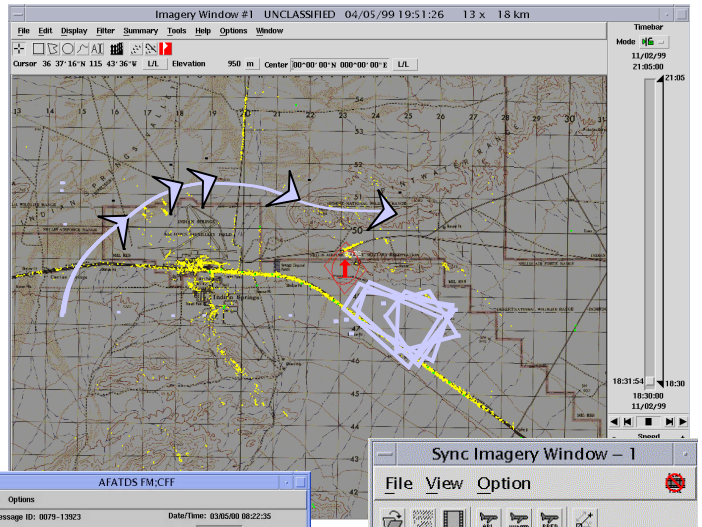
MTI

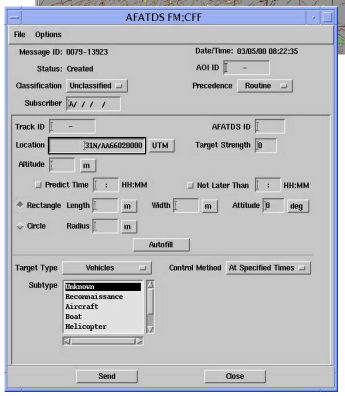
UAV

Mobile Graphical Components

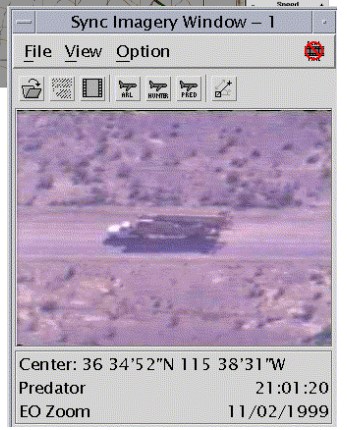
AFATDS

COTS/GOTS Visualization Package



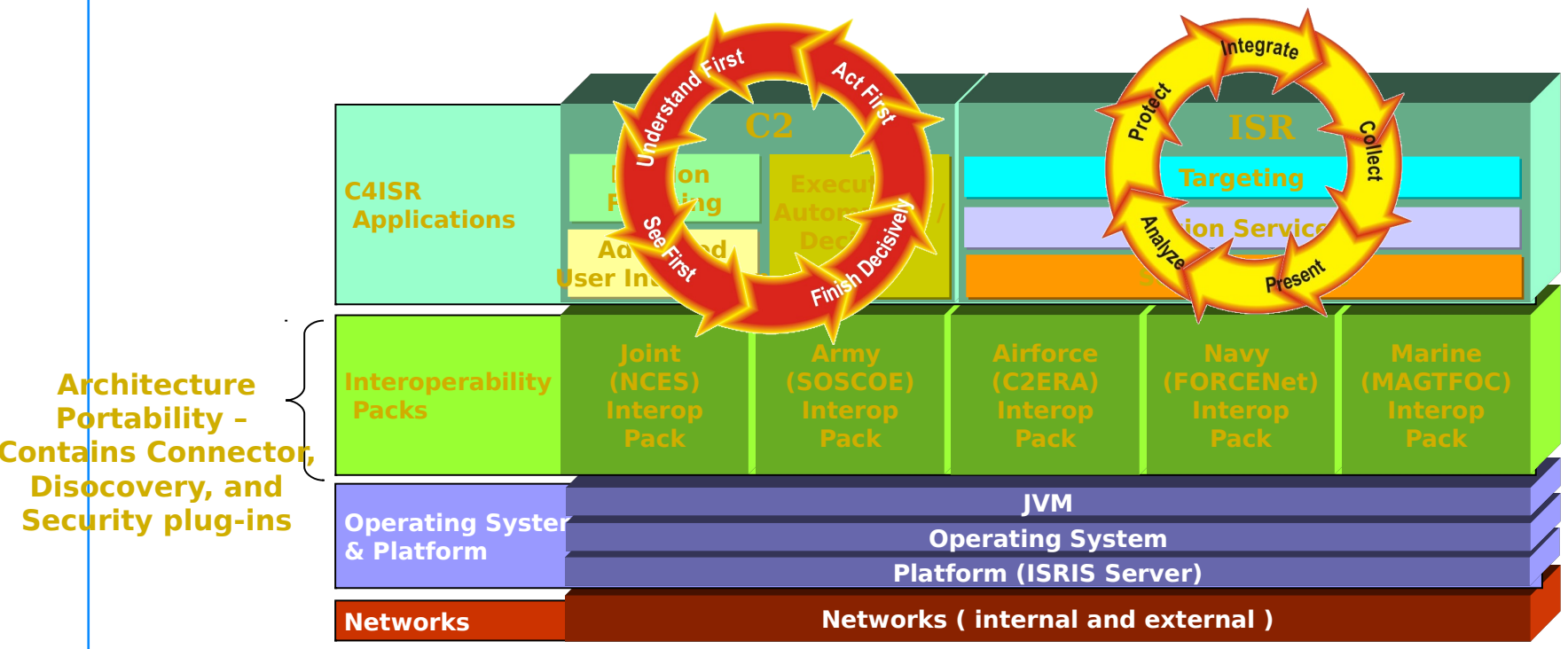


Targeting Interface Provided by AFATDS



UAV Viewing App Provided by CGS

Interoperability Strategy



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Steps to Achieve Interoperability via SOA Implementation

- **Begin the evolution- Publish existing services**
  - Each POR responsible for publishing key service
    - Design for technology change
  - Enable existing applications for network usage
    - SBA wrappers, Web-Service access
- **Develop strategy for services discovery**
  - Decision is key
  - Allow for evolution of standards by isolation of applications from OE's
- **Begin decomposition of monolithic legacy applications**
  - Critical services first
    - Self-contained, loosely-coupled services
    - Modify as necessary for more robust service

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Steps to Achieve Interoperability to via SOA Implementation

- **Re-choreograph existing business (war fighting) processes to capitalize on deployable services**
  - Focus on applications needed by war fighters first
  - Providing flexibility to the user is key to innovation
  - Make services user-transparent, who uses will change

…Finally…..

- **Establish de-confliction rules among services**
  - Important to get agreement on deployment from “owners” of critical data
- **Get serious about the security solution**
  - Security policy must address evolution of service/data usage
  - Objective, reduce HW complexity at mobile levels
    - Eliminate multiple LANS,
    - Workstation complexity - MILS workstation, perhaps

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Recommendations and Conclusions

- **Government/industry collaboration is key**
  - Frank and open dialog, leading to quick decisions
  - NDIA provides an excellent, unbiased forum
- **Service "equities" and flagship programs should be incorporated wherever feasible**
  - Essential to achieve "buy in" across Government
  - Necessary to garner prime contractor support
- **Establish joint Govt/industry execution team**

Joint SOA will enable net-centric interoperability!

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